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Laryngeal Assimilation in Dutch and Bangla Consonant Clusters

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Abstract: In the analysis of laryngeal features in consonant clusters (C1C2) precipitating from compound constructions in Dutch, specifically directional voicing assimilation (Lombardi 1995), a new constraint was proposed in the Optimality Theoretic framework on the word level in order to take into account progressive voicing resulting from affixation in Dutch (Borowski 2000). However, the proposed analysis wrongly predicts the progressive voicing in C1C2 clusters with a fricative C2, unless it takes into account Lombardi's markedness constraint (Borowski 2000). This paper proposes new faithfulness constraints for both progressive as well as regressive assimilation in C1C2 clusters in compounds as well as affixed words in Dutch and extends the analysis to laryngeal assimilation in C1C2 clusters in Bangla by re-ranking the same constraints.

1. Introduction

This paper looks at the assimilation of laryngeal features, specifically voicing and aspiration, in consonant clusters (C1C2) resulting from compound constructions in Dutch and Bangla within the framework of Optimality Theory. Building on Linda Lombardi's analysis (Lombardi 1995) of directional voicing assimilation of Dutch consonant clusters (C1C2) Toni Borowski proposes a new constraint on the word level in order to take into account progressive voicing resulting from affixation in Dutch. The analysis falls short in that it wrongly predicts the progressive voicing in C1C2 clusters with a fricative C2, unless Lombardi's markedness constraint is added to the analysis (Borowski 2000). In this paper I propose new faithfulness constraints for both progressive as well as regressive assimilation in C1C2 clusters in compounds as well as affixed words. In the latter section of this paper I extend the analysis to Bangla by re-ranking the same constraints.

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1.2 Methodology

The analysis of laryngeal assimilation in this paper is implemented within the theoretical framework of Optimality Theory (OT) as developed by Prince and Smolensky (1993) and McCarthy (2008). OT is a linguistic model that postulates observable forms in language to precipitate from the resultant interaction of conflicting constraints. OT comprises the following primary components:

i. GEN: generates possible competing candidates from the given input.
ii. CON: selects candidates by means of strictly ordered and ranked violable constraints.

    There two basic types of constraints:

    a. Faithfulness Constraints: require the input resemble the output in some form.
    b. Markedness Constraints: impose well-formedness requirements on the output.

iii. EVAL: selects the optimal candidate through conflicting constraints.

2. Laryngeal Assimilation and OT Constraints

Laryngeal assimilation in consonant clusters is said to be an interaction of positional faithfulness constraints with the default direction of assimilation stated to be one that is regressive i.e. C1 moves towards C2 (Lombardi 1999). Progressive assimilation i.e. C2 moves towards C1, as Lombardi and Borowski point out, are cases where certain markedness constraints pertaining to special circumstances in which morphological or other phonological factors may reverse the direction of assimilation. The conflicts between the faithfulness constraints and the markedness constraints can be resolved to account for directional laryngeal assimilation and neutralization in all languages (Lombardi 1999).

2.1. Laryngeal Assimilation in Dutch

In Dutch laryngeal assimilation primarily refers to voicing assimilation. Voicing assimilation in C1C2 clusters is very interesting in that the default pattern is regressive unless a cluster comprises a fricative in the C2 position in which case the entire cluster becomes voiceless regardless whether C1 or C2 is voiced.

In terms of aspiration, the feature aspirated is only used to characterize the voiced glottal fricative /h/ and all other segments are said to be unaspirated (Booij 1995).

The voicing assimilation in compound word structures is exemplified in the data below, collected from Trommelen and Zonneveld (1979):

/p+d/	bd	stropdas	'tie'
/t+b/	db	witboek	'white book'
/k+d/	gd	zakdoek	'handkerchief'
/d+k/	tk	bloedkoraal	'red coral'
/d+p/	tp	huidplooi	'skin crease'
/b+k/	pk	slobkous	'gaiter'
/s+b/	zb	kasboek	'cash book'
/x+b/	ɣb	lachbui	'fit of laughter'
/f+b/	vb	lafbek	'coward'
/ɣ+t/	xt	hoogtij	'heyday'
/z+p/	sp	kaaspers	'cheese press'
/v+k/	fk	lijfknecht	'serf'
/k+v/	kf	boekvorm	'book form'
/p+z/	ks	diepzee	'deep sea'
/t+z/	ts	hartzeer	'heartache'
/s+v/	sf	bosveen	'peat'
/f+z/	fs	strafzaak	'trial'
/x+v/	xf	pechvogel	'unlucky person'
/d+v/	tf	handvat	'handle'
/d+z/	ts	Noordzee	'North Sea'
/b+z/	ps	krabzeer	'scratching sore'
/z+v/	sf	kaasvorm	'cheese mould'
/v+z/	fs	dijfzand	'quicksand'
/ɣ+v/	xf	hoogvlakte	'plateau'

Affixed words: (Booij 1995, Borowski 2000)

strap+de	strapte	'stopped'
maf+de	mafte	'snoozed'
krab+de	krabde	'scratched'
rad+zam	ratsam	'advisable'
verk+zam	verksam	'effective'

2.1.1. Generalizations in Dutch

The generalizations for Dutch voicing assimilation are:

- Voicing in onsets is ranked higher than voicing in codas.
- In C1C2 clusters in compounds comprising both stops in C1 and C2 position, voicing in C1 assimilates to C2.
- In C1C2 clusters in compounds comprising a fricative in C1 position and a stop in C2 position, voicing in C1 assimilates to C2.
- In C1C2 clusters in compounds comprising an obstruent in C1 position and a fricative in C2 position, both C1 and C2 become devoiced.
- In C1C2 clusters where C2 is the onset of an affix, and C1 is any obstruent while C2 is a stop, C2 assimilates to C1.
- In C1C2 clusters where C2 is the onset of an affix, and C1 is any obstruent while C2 is a fricative, both C1 and C2 become devoiced.

2.2. The Constraints

Lombardi posits two faithfulness constraints and two markedness constraints to account for directional assimilation of laryngeal features in all languages exemplifying with Swedish, Yiddish, Polish, German and English (Lombardi 1999).

IDOnsLar: (also IDOns): Consonants in onsets should be faithful to underlying laryngeal features

IDLar: Consonants should be faithful to underlying laryngeal features

Agree: Consonants should agree in voicing

*Lar: Have no laryngeal features

For Dutch however she proposes a high ranked markedness constraint to account for fricatives in C2 position.

FricVoice: Postobstruent fricatives must be voiceless.

Borowski on the other hand uses one extra constraint based on post-lexical factors to account for progressive voicing in Dutch affixed words which she calls word-faithfulness (Borowski 2000).

IDWD: Do not change features of a word.

The addition of this constraint is used to account for progressive assimilation in affixed words as shown below:

stap(stem)+(de)affix

stap+de	Agree	IDWD	IDOnsLar	*Lar	IDLar
→stapte			*		*
stapde	*!			*	
stabde		*		**	*
stabte	*!	*	*	*	*

However, the addition of this constraint fails to analyse devoicing C1C2 clusters with postobstruent fricatives:

boekvorm	Agree	IDWD	IDOns	*Lar	IDLar
!!! boekform		*	*		*
boekvorm	*!	*		*	
→boegvorm		*		**	*
boegform	*!		*	*	*

More importantly it even wrongly predicts data on devoicing in affixed words as shown below:

rad(stem)+zam(affix)

rad+zam	Agree	IDWD	IDOnsLar	*Lar	IDLar
!!! ratsam		*!	*		**
→radzam				**	
ratzam	*!	*		*	*
radsam	*!		*	*	*

I propose instead to split one of the faithfulness constraints to two separate constraints for stops and fricatives to get the desired output and merge the faithfulness constraints for stops with the word-faithfulness constraints in order to correctly predict the affixed data from the compounds.

The constraints are described in the following section.

I have adopted Linda Lombardi's basic constraints and slightly modified them.

a) Faithfulness Constraints:

Lombardi's primary faithfulness constraint was IDOnsLar which stated that consonants in the given position were to be faithful to underlying laryngeal specifications. I propose to split this constraint into two (IDOnsSTOP and IDOnsFric) to account for the differing direction of assimilation in Dutch on the basis of stops and fricatives. Moreover, as we have seen in Dutch, stops in onset positions in words rather than those in affixes remain faithful to underlying laryngeal features, I propose to merge Borowski's IDWD with the IDOnsSTOP.

1. IDentWordOnsetSTOP(Laryngeal): (abbreviated to IDWDOnsSTOP)

   Stops in the stated position should be faithful to underlying laryngeal specification
2. IDentOnsetFricative(Laryngeal): (abbreviated to IDOnsFRIC)

   Fricatives in the stated position should be faithful to underlying laryngeal specification
3. IDent(Lar): (abbreviated to IDLar)

   Consonants should be faithful to underlying laryngeal specification.

The IDentOnset constraints account for violations of differing laryngeal feature specifications between input and output correspondences of consonants in a C1C2 cluster. These constraints are sensitive to the position of the consonant i.e. C2.

The IDLar constraint is one that is violated every time an output consonant differs in laryngeal specification from its input.

b) Markedness Constraints:

1. *Lar: do not have laryngeal features.

   The *Lar constraint will be violated if a consonant bears laryngeal features in the form of voicing or aspiration.
2. Agree: Consonant clusters should agree in voicing.

   The Agree constraint is only violated when a pair of consonants does not agree in voicing i.e. they have not assimilated. Lombardi points out that voicing assimilation does not have long-distance effects and hence does not cross vowels. Therefore, it only applies to cluster situations. She also denotes

that this constraint plays no role in the direction of assimilation as directionality is generated by means of constraint interactions (Lombardi 1999).

In the next section we will see how these constraints are ranked in respect to each other in order to generate the desired outputs in Dutch and Bangla.

3. *CODAvoice: Obstruents in syllable-final positions should be voiceless.

   This constraint is taken into account since Dutch has word final devoicing. However, it will be ranked low in Bangla.

2.2.1 Constraint Ranking in Dutch

1) *Lar>>IDlar

boekvorm	*Lar	IDLar
→boekform		*
boekvorm	*	

As C1 and C2 assimilate in a C1C2 cluster the output of at least one of the consonants will always differ in its laryngeal specification from its input and therefore IDLar will always be violated by the winning candidate. However *Lar is not always violated and hence in certain cases, as in the example above, needs to be ranked higher than IDLar to determine the winning candidate.

2) IDWDOnsSTOP>>*Lar

kasboek	IDWDOnsSTOP	*Lar
→kazboek		**
kaspoek	*	

As the default assimilation is regressive, and may retain voicing if the onset (C2) is voiced it is necessary for IDWDOnsSTOP to dominate *Lar.

3) IDWDOnsSTOP >> IDLar

kasboek	IDWDOnsSTOP	IDLar
→kazboek		*
kaspoek	*	*

As assimilation to the onset will require laryngeal feature in the coda to change it is necessary for IDWDOnsSTOP to dominate IDLar. The primary difference between the faithfulness constraints being that of positionality, IDWDOnsSTOP must dominate IDLar to be more faithful to laryngeal features of onsets than codas or elsewhere.

4) IDWDOnsSTOP>>*CODAvoice

kasboek	IDWDOnsSTOP	*CODAvoice
→kazboek		*
kaspoek	*	

IDWDOnsSTOP must also dominate *CODAvoice as a voiced onset in C2 will motivate a voiceless coda in C1 to become voiced.

5) *CODAvoice>>IDLar

boekvorm	*CODAvoice	IDLar
→boekform		*
boekvorm		

*CODAvoice will dominate IDLar as regressive assimilation devoices codas which conflicts with the underlying form.

6) *CODAvoice>>*Lar

kasboek	*CODAvoice	*Lar
→kazboek	*	**
kazpoek	*	*

*CODAvoice will dominate *Lar as assimilation to a voiced obstruent results in two violations of *Lar but only one of *CODAvoice.

7) Agree >> {IDWDOnsSTOP, *CODAvoice *Lar, IDLar}

kasboek	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar
→kazboek			*	**	*
kaspoek		*!			*
kazpoek	*!	*	*	*	**
kasboek	*!			*	

As C1C2 clusters will assimilate and hence agree in voicing, it is necessary for Agree to dominate the faithfulness constraints as well as *CODAvoice and *Lar if the assimilation retains voicing.

8) Voicing assimilation will always occur if the constraints are ranked as follows:

Agree >> *Lar >> IDLar

However it is the positional constraints IDWDOnsObsSTOP and IDOnsFRIC that dictate the direction of the assimilation.

9) Agree >> {IDWDOnsSTOP, *CODAvoice *Lar, IDLar}>>IDOnsFRIC

Thus the ranked constraints are:

Agree >> IDWDOnsSTOP >> *CODAvoice >>*Lar >> IDLar >> IDOnsFRIC

In a language like Dutch where voicing assimilation is faithful in obstruent onsets only, it is necessary to have a constraint such as IDWDOnsSTOP which ranks higher than the other constraints including IDFric but is dominated by Agree. In languages where voicing in assimilation is faithful in stops as well as fricative onsets both IDWDOnsSTOP and IDOnsFRIC can dominate the other constraints without being ranked with respect to each other, but in themselves being dominated by Agree.

2.3. Summary tableaux

Progressive and regressive voicing assimilation in Dutch compound structures and affixed words are given below:

A. Stem + Affix: Progressive Assimilation

1. stap+de

stap+de	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar	IDOnsFRIC
→stapte					*	
stabde			*	**	*	
stapde	*!			*	*	
stabte	*!		*	*	**	

2. rad+zam

radzam	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar	IDOnsFRIC
→ratsam					*	*
radzam			*!	**		
ratzam	*!			*	*	
radsam	*!		*	*	*	*

B. Word+Word, C1=STOP, C2=FRIC: Progressive Assimilation

boekvorm	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar	IDOnsFRIC
→boekform					*	*
boekvorm	*!			*		
boegvorm			*!	*!*	*	
boegform	*!		*	*	*	*

C. Word+Word, C1=FRIC, C2=STOP: Regressive Assimilation

kasboek	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar	IDOnsFRIC
→kazboek			*	**	*	
kaspoek		*!			*	
kazpoek	*!	*	*	*	**	
kasboek	*!			*		

D. Word+Word, C1=STOP, C2=STOP: Regressive Assimilation

slobkous	Agree	IDWDOnsSTOP	*CODAvoice	*Lar	IDLar	IDOnsFRIC
→slopkous					*	
slobkous	*!		*			
slobgous		*!	*	*	*	
slopgous	*!	*		*	**	

3. Laryngeal Assimilation in Bangla

Although in Dutch the focus is primarily on voicing assimilation as aspiration does not play a significant role; however, both voicing (assimilation) and aspiration (neutralization) are pertinent issues for

Bangla. As we will see in the following data, Bangla has regressive assimilation in C1C2 clusters where both C1 and C2 are obstruents and there is no difference in directionality of assimilation on the basis of different obstruents in onset positions.

The regressive voicing in compound structures in Bangla is exemplified in the data posited below (Chatterjee 1939):

/g+k/	kk	rag kɔra	→ rakkɔra	'get angry'
/c+g/	jg	pach golap	→ paʄgolap	'five roses'
/b+k/	pk	ʃɔb kaʄ	→ ʃɔpkaʄ	'all work'
/c^{h}+d^{h}/	ʄd^{h}	mac^{h} d^{h}ɔra	→ maʄd^{h}ɔra	'catching fish'
/b^{h}+k/	pk	lab^{h} kɔra	→ lapkɔra	'make profit'
/b+s/	ps	ʃɔb sigaret	→ ʃɔpsigaret	'all cigarettes'
/t+z/	dz	ʃat zakat	→ ʃadzakat	'seven charities'

3.1. Generalizations in Bangla

The generalizations for Bangla voicing assimilation are:

Voicing in onsets is ranked higher than voicing in codas.

In C1C2 clusters in compounds comprising both obstruents in C1 and

C2 position, voicing in C1 assimilates to C2.

In C1C2 clusters where C1 is aspirated, assimilation results in loss of C1 aspiration.

3.2 Ranking Constraints in Bangla

Bangla ranking constraints patterns in the same way as Dutch as shown below in accordance to the ranking arguments posited in section 2.2.1:

1) *Lar >> IDLar

labhkora	*Lar	IDLar
→lapkora		**
labhkora	**	

2) IDWDOnsSTOP >> *Lar

machdhora	IDWDOnsSTOP	*Lar
→majdhora		***
macdhora		**

3) IDWDOnsSTOP >> IDLar

labhkora	IDWDOnsSTOP	IDLar
→lapkora		**
labhkora		

4) Agree >> {IDWDOnsSTOP, IDOnsFRIC, *Lar, IDLar} >> *CODAvoice

Agree must dominate all other constraints in order to motivate assimilation.

The primary difference between Dutch and Bangla constraint ranking is as follows:

5) IDOnsFRIC >>*Lar >> IDLar

ʃatzakat	IDOnsfric	*Lar	IDLar
→ʃadzakat		**	*
ʃatsakat	*		*

Given that fricative onsets remain faithful and instigate assimilation it can motivate voicing and thus violate *Lar and at least one of the C1C2 cluster will change in underlying laryngeal specification violating IDLar and thus these two constraints need to be dominated by IDOnsFRIC.

6) There is no relative ranking of IDWDOnsSTOP and IDOnsFRIC as both of these jointly act as IDOns. It is the treatment of fricative onsets of Dutch that motivated the split in the faithfulness constraint.

7) *CODAvoice will be ranked the lowest as Bengali doesn't have word final devoicing.

Hence the re-ranked constraints stand thus:

Agree >> {IDWDOnsSTOP, IDOnsFRIC} >> *Lar >> IDLar >> *CODAvoice

3.3 Summary Tableaux

Regressive voicing assimilation in Bangla compound structures are given below:

1) Regressive Devoicing, C1=STOP, C2=STOP

labhkora	Agree	IDWDOnsSTOP	IDOnsFRIC	*Lar	IDLar	*CODAvoice
→lapkora					**	
labhkora	*!			**		*
labhgora		*!		***	***	*
laphkora				*!	*	
lapgora	*!	*		*	***	

2) Regressive Voicing, C1 = STOP, C2=STOP

machdhora	Agree	IDWDOnsSTOP	IDOnsFRIC	*Lar	IDLar	*CODAvoice
→majdhora				***	**	*
machdhora	*!			***		
majhdhora				***!*	*	*
macdhora	*!			**	**	
machthora		*!		***	*	
macthora		*!		*	**	
majthora	*!	*		**	***	*
majhthora	*!	*		***	*	*

3) Regressive Voicing, C1 = STOP, C2=FRIC

ʃatzakat	Agree	IDWDOnsSTOP	IDOnsFRIC	*Lar	IDLar	*CODAvoice
→ʃadzakat				**	*	*
ʃatzakat	*!			*		
ʃatsakat			*!		*	*
ʃadsakat	*!	*		*	*	*

4. Conclusion

In this paper we saw that the constraints posited by Lombardi and compounded by Borowski were inadequate in analyzing directional assimilation of voicing in C1C2 clusters. I proposed new constraints building on the previous ones in order to account for both regressive as well as progressive voicing assimilation in Dutch compound structures as well as affixed words. Building on Lombardi and Borowski's work the new constraints proposed were the faithfulness constraints IDWDOnsSTOP and IDOnsFRIC and the markedness constraint *CODAvoice with the ranking for Dutch being;

Agree >> IDWDOnsSTOP >> *CODAvoice >>*Lar >> IDLar >> IDOnsFRIC

These constraints were then re-ranked to analyse regressive voicing assimilation in C1C2 compound structures in Bangla, whereby the ranking is:

Agree >> {IDWDOnsSTOP, IDOnsFRIC} >> *Lar >> IDLar >> *CODAvoice

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